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# Coca-Growing Areas in South America: Substantial Room To Maneuver

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An Intelligence Assessment

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GI 82-10214  
October 1982

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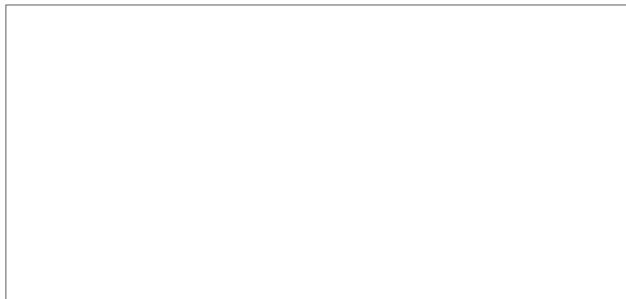
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# **Coca-Growing Areas in South America: Substantial Room To Maneuver**

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**An Intelligence Assessment**



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*GI 82-10214  
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**Coca-Growing Areas  
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**Key Judgments**

*Information available  
as of 27 September 1982  
was used in this report.*

All of the cocaine imported yearly into the United States—some 40 to 48 tons, according to the US National Narcotics Intelligence Consumer Committee (NNICC)—comes from South America. Bolivia and Peru are the major producers and Colombia the primary processor.

Coca is currently grown on approximately 63,000 to 96,000 hectares, but this area could be expanded rapidly. Indeed, such efforts are under way in areas such as the Rio Vaupes region of Colombia.

The expansion or relocation of coca-growing operations is somewhat constrained by factors such as the available transportation, labor supply, the extent of government control, and the possible activity of insurgent groups, but the large size of the potential growing area that remains portends problems for narcotics monitoring and control programs. Traffickers have wide latitude for shifting or expanding cultivation in response to host government enforcement pressures or to increased demand, thus taxing severely the resources dedicated to controlling illicit coca production and drug trafficking.

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**Figure 1**  
**Cocaine Production**

<b>Coca Leaves</b> ↓	Dried coca leaves are covered with water and crushed into a paste. Kerosene or gasoline is added and the solution stirred for several hours. Sodium bicarbonate is added, the mix stirred well, and allowed to stand for six hours. Water and kerosene layers are then separated, and the kerosene discarded or reused. Strong ammonia is added to the water layer, precipitating cocaine base. The crude base is sun dried and transported to the crystal lab.
<b>Crude Cocaine Base</b> (Sulfato) ↓	Cocaine base is dissolved in dilute sulfuric acid and boiled. It is cooled and filtered to remove solid impurities. Potassium permanganate solution is added until pink color remains. After standing four to six hours, the solution is filtered to remove solids. Ammonia water is added to precipitate purified cocaine base. Precipitate is washed with water and sun dried.
<b>Purified Cocaine Base</b> ↓	Cocaine base is dissolved in ethyl ether and filtered to remove solid impurities. A mixture of ether, acetone, and concentrated hydrochloric acid is added to precipitate cocaine hydrochloride. The precipitate is dried carefully, using bright lights, and packaged for sale.
<b>Cocaine Hydrochloride</b>	

  
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## Coca-Growing Areas in South America: Substantial Room To Maneuver

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### Introduction

Coca has been grown for centuries in South America along the eastern slopes of the Andes Mountains. It is legally cultivated for a large native population in Peru and Bolivia and a smaller group in Ecuador who chew the leaves. In addition, a small amount is exported for pharmaceutical purposes. Since the early 1900s, however, coca has been grown primarily for the illicit production of cocaine (cocaine hydrochloride). Peru, Bolivia, and Colombia have laws that prohibit both the cultivation of coca—in areas other than those prescribed by government regulations—and the manufacture of cocaine, but these laws are not effectively enforced.<sup>1</sup> Should any of the countries where illicit coca is grown begin effective control programs, growers would almost certainly take measures to counter such efforts. Chief among such countermeasures would be a shift of coca cultivation to areas of weaker government control. This paper defines the area within the four major coca-producing countries of South America that is agronomically suitable for coca cultivation and discusses the probable effect on enforcement efforts of any relocation.

### The Coca Plant

*Erythroxylon coca*, the species of coca plant generally used for the production of cocaine, is native to South America and is found in abundance on the eastern slopes of the Andean chain. According to numerous studies by US academicians and the US Department of Agriculture, coca is fairly resistant to disease and grows best:

- At altitudes between 500 and 2,500 meters.
- In porous soils that are rich in humus, iron, and magnesium.
- In a humid (80- to 90-percent average relative humidity), frost-free zone with a mean annual temperature between 18 and 25 degrees Celsius.

Wild coca bushes are usually 4 to 5.5 meters tall although some plants may reach a height of 9 meters

or more. To facilitate harvesting, cultivated coca is normally kept pruned to about 2 meters. Cocaine alkaloids are found in the plant's leaves, and thus harvesting consists of stripping the leaves off the trees. The coca plant can be harvested three to four times a year, beginning as early as 14 months after initial planting and continuing for as long as 20 years— although the yield and alkaloid content of the leaves diminish with age.

### Traditional and Potential Coca Cultivation Areas

The principal coca cultivation areas are located in Peru and Bolivia and minor growing areas in Ecuador and Colombia. Since the mid-1970s, Peru and Bolivia have made efforts to control cultivation and production of cocaine. The governments of both countries have enacted legislation that restricts licit coca cultivation—which meets the needs of the indigenous population—to traditional growing regions. These restrictions, however, generally have not been effective; traffickers have managed to evade or subvert government attempts at enforcement.

The current coca-growing areas of Bolivia, Colombia, Ecuador, and Peru produce quantities far in excess of legal domestic demand and export. For example, according to the US National Narcotics Intelligence Consumer Committee (NNICC) estimates, the traditional growing areas in Peru and Bolivia could produce more than 75,000 tons of coca leaf annually, which could be converted to some 150 tons of cocaine hydrochloride. These cultivated areas, moreover, represent only a small percentage of the territory that could agronomically support coca growth (table 1). Indeed, the area where coca cultivation is feasible in Bolivia, Colombia, Ecuador, and Peru is roughly 2.5 million square kilometers, an area equal to about 40 percent of the contiguous United States:

- **Bolivia.** The largest area of potential cultivation in Bolivia includes virtually the entire northern and eastern sections of the country, from the eastern

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Figure 2. *Erythroxylon coca*,  
used for the production of  
cocaine.



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slopes of the Andes to Brazil. Smaller sections of potential coca cultivation are found in the Yungas region of La Paz Department, the Chapare region of Cochabamba Department, and in the area extending southward from Santa Cruz. This is about 40 percent of Bolivia's total land area.

- **Colombia.** Some 88 percent of Colombia is physically suitable for coca cultivation. Only the areas along the Atrato and Cauca Rivers and in the Andes Mountains are not naturally suitable for coca cultivation.
- **Ecuador.** Coca can potentially be grown on almost two-thirds of the territory of Ecuador. The largest area with potential for coca growth lies east of the Andes, extending to Ecuador's borders with Colombia and Peru. A second major area of potential cultivation is found along the western Andean slopes.
- **Peru.** Nearly three-fourths of Peru—including both western and eastern slopes of the Andes—is a potential coca-growing area.

These estimates of potential growing areas exclude other South American countries. Coca has not traditionally been grown to an appreciable extent in Venezuela and Brazil. Although coca could be grown in climatologically suitable areas—such as those parts of Brazil contiguous to Colombia and Peru—we believe it unlikely that traffickers, given the range of alternative sites already available, will soon expend the effort needed to develop these remote regions.

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#### Constraints on Illicit Coca Cultivation

Because the potential growing area is enormous in comparison with the area currently used to grow coca, traffickers have substantial latitude for relocation in response to pressure from government narcotics control efforts. In selecting suitable alternative sites for their illicit fields, however, traffickers are constrained by existing logistic infrastructure, extent of government control, proximity of terrorist or insurgent activity, and accessibility to labor, processing chemicals, and other materials needed for cocaine production.

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**Table 1**  
**South America: Current and Potential**  
**Coca Cultivation**

	Area (square kilometer)	Current		Potential		
		Area (square kilometer)	Percent of Total	Area (square kilometer)	Percent of Total	Percent of Potential Land Currently Under Coca Cultivation
<b>Total</b>	<b>3,796,940</b>	<b>630-960</b>	<b>0.02-0.03</b>	<b>2,525,000</b>	<b>67</b>	<b>0.03 to 0.04</b>
Bolivia	1,098,160	250-330	0.02 to 0.03	440,000	40	0.06 to 0.08
Colombia	1,139,600	30	NEGL	1,000,000	88	NEGL
Ecuador	274,540	NEGL	NEGL	175,000	64	NEGL
Peru	1,284,640	350-600	0.03 to 0.05	910,000	71	0.04 to 0.07

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**Infrastructure.** A region's existing infrastructure is an important determinant in the location of illicit coca fields. US Embassy reports show that coca-growing sites often are adjacent to transportation arteries such as navigable rivers and all-weather roads or to established airfields. Many illegal coca fields are located in remote areas accessible only by airplane, but according to US Drug Enforcement Administration (DEA) reports, such operations are usually the work of a major trafficking organization that can afford to build and maintain its own airfields. Because the small-scale traffickers and coca cultivators are more dependent upon existing labor and transportation systems, therefore, much of the projected potential coca cultivation area could be developed only by large trafficking groups with sufficient resources at their disposal to offset the initial development costs.

**Government Control.**

major coca-growing areas are normally located where the police and military are not strong enough to pose a serious threat to traffickers. Moreover, those government forces stationed in coca-producing regions often become incorporated into the trafficking structure through corruption or intimidation. In some instances entire communities are involved in narcotics trafficking, with local officials actively thwarting central

government enforcement activities. The inclination or ability of the government to exercise control over all parts of its national territory, therefore, will be critical in the selection of future coca cultivation sites.

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**Terrorist-Insurgent Activity.** In Peru and especially in Colombia, the selection of new coca-cultivation sites depends in part on the location of terrorist or insurgent groups, with whom traffickers generally prefer to avoid confrontations. It is doubtful, then, that traffickers would establish new cultivation sites in areas of heavy insurgent or terrorist activity where there is a likelihood of detection by government forces.

in regions where both traffickers and insurgents or terrorists conduct operations, the latter groups have on occasion extracted money and arms from the traffickers in return for protection or permission to use their territory. The additional cost of operating in an insurgent-controlled area, both in terms of money and risk of detection by security forces, thus also will affect the choice of future coca-cultivation sites.

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**Additional Considerations.** Site selection will also depend to some degree on the traffickers' ability to obtain processing chemicals and sufficient labor to

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**Identifying Potential Areas**

*Identification of potential growing areas for this report was made using the Holdridge Life Zone Classification System. Widely used to determine potential growing areas of selected plants, this system is predicated on the assumption that major vegetation units (life zones) are characterized solely by average temperature, precipitation, and moisture regimes. Comparison of Holdridge ecological maps of South America with frost-free areas determined the boundaries of potential coca-cultivation areas.*

*This approach, however, has several limitations:*

- The methodology understates the potential growing area because it defines only the areas where coca can be "naturally grown" and does not consider modern agronomic techniques which can be used to reduce the impact of physical constraints.*
- The methodology overstates the potential growing area because it fails to exclude areas that are unlikely or unable to support coca growth—such as urban areas, highways, and rivers—and does not exclude areas that lack the infrastructure—roads, labor force, and the like—to support profitable production.*

*Despite its limitations, the system is the best available means for determining possible cultivation areas from simple climatic data.*

prepare, cultivate, harvest, and protect the fields. Depending on the size and location of the site, additional expenses might include the cost of constructing an airfield, hangar, drying facility, storage sheds, and housing. The more remote the site, the more difficult and expensive it is to maintain. It is also possible that the availability of suitable land for coca cultivation may be affected by competition among major trafficking groups. Normal friendly relations

**Table 2**  
**Cocaine Yields <sup>a</sup>**

	Age of Coca Plant (years)		
	One to Two	Three to Four	Four to Eight
Coca dry leaf weight per hectare per harvest (kilos—assuming 1 plant per square meter)	33	267	833
Cocaine alkaloid content (percent)	0.28	0.28	0.28
Number of harvests per year	4	4	4
Cocaine hydrochloride yield per hectare of coca cultivation (kilos)	0.37	2.99	9.33

<sup>a</sup> Values for average coca plant age, harvesting frequency, plant height, planting density, and cocaine alkaloid content are based on DEA field reporting and laboratory analysis. Even so, yields are illustrative and vary considerably by region.

among the major trafficking groups may break down if one feels its territory is being infringed upon.

**Outlook**

The development of new coca-cultivation zones will depend on domestic and international demand as well as on pressure from narcotics control programs. So long as traffickers can produce sufficient quantities to meet current demand and do not feel pressure from the government, they are unlikely to relocate their operations. If demand increases or narcotics enforcement measures are successful, we believe it probable that traffickers will expand or relocate their operations in the general areas indicated.

The impact on production of cocaine if a major shift or expansion in the coca-growing area occurs would be marked but difficult to forecast. Much depends on yields in the newly developed areas (table 2). According to academic reports, such yields vary considerably, from about 260 kg to nearly 5,000 kg of dry leaf per hectare annually in Bolivia alone, depending on the type of soil, age of the plant, the use of fertilizer,

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and the number of harvests per year. The ratio of dry coca leaf to cocaine hydrochloride is likewise highly variable, from 100 kg to 500 kg of leaves per kilogram of cocaine (cocaine hydrochloride), depending again on the age of the plant and the number of harvests per year but also on the extraction method used. The amount of cocaine hydrochloride per hectare could thus vary from about 0.5 kg to 50 kg based on these estimates alone. [REDACTED]

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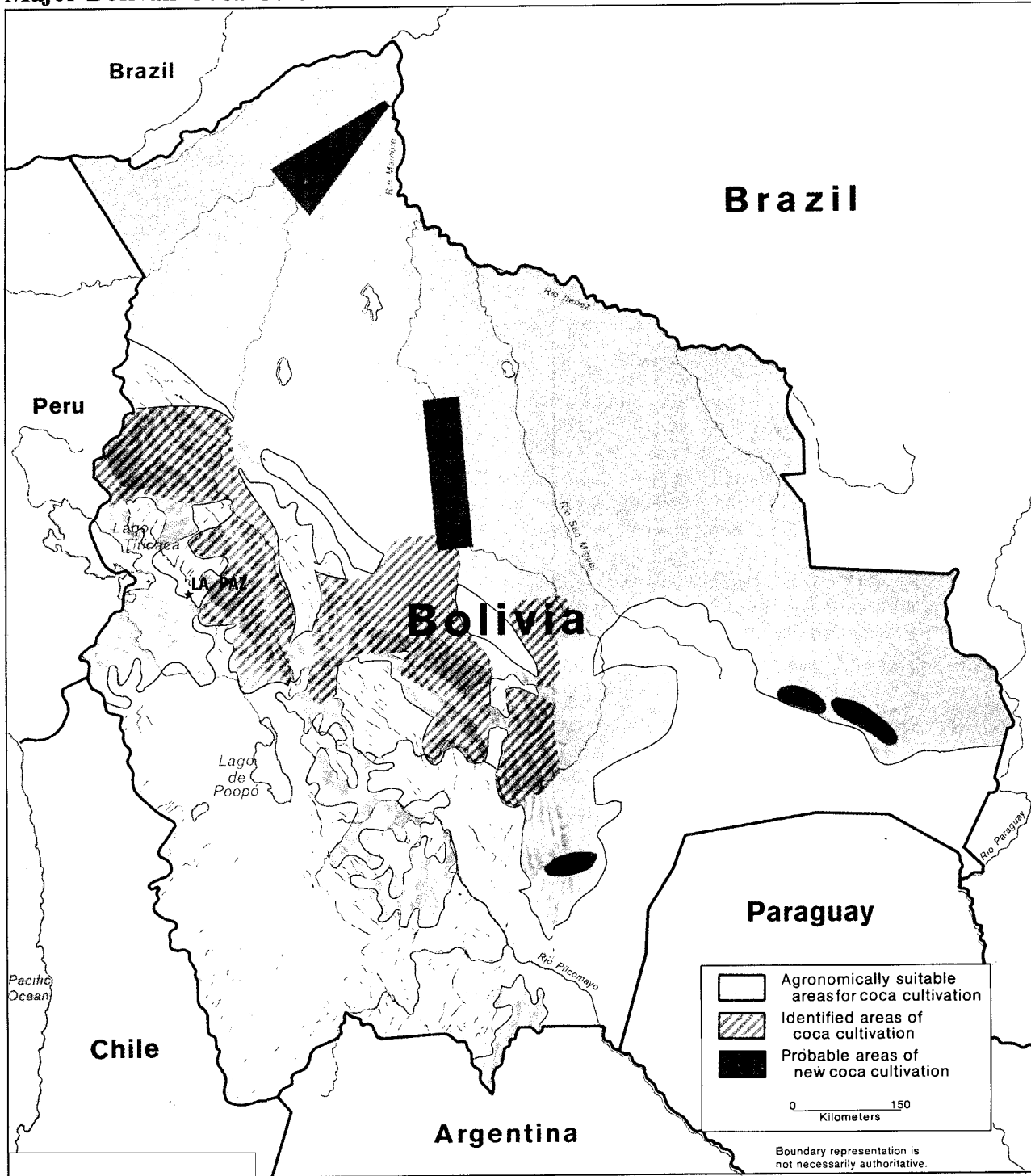
The United States is the principal consumer of South American cocaine and is thus directly affected by any expansion of coca cultivation and production. The expansion or relocation of illicit coca cultivation will not be constrained by the availability of land, and traffickers will have wide latitude for movement in response either to government enforcement pressures or to increased demand. This will make the implementation of narcotics control programs more difficult as drug entrepreneurs are likely to shift their fields and trafficking operations to counter government enforcement efforts. Relocation decisions probably will be based primarily on the logistic and operational constraints associated with getting the cocaine to market. In any event, such shifts will increase the cost of programs to monitor or control illicit narcotics trafficking. [REDACTED]

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### Major Bolivian Coca Cultivation Areas



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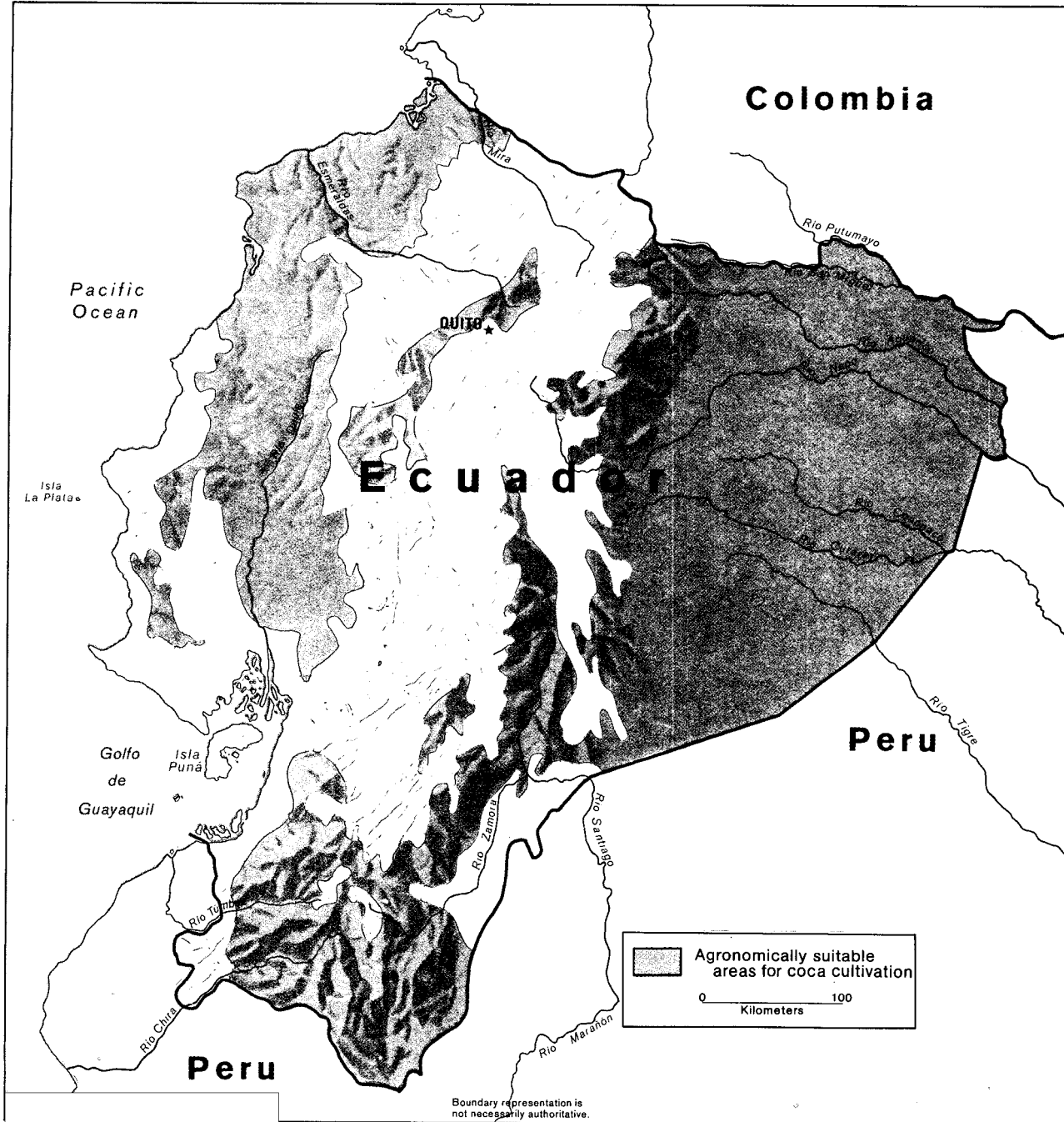
## Major Colombian Coca Cultivation Areas



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### Major Ecuadorean Areas Suitable for Coca Cultivation



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